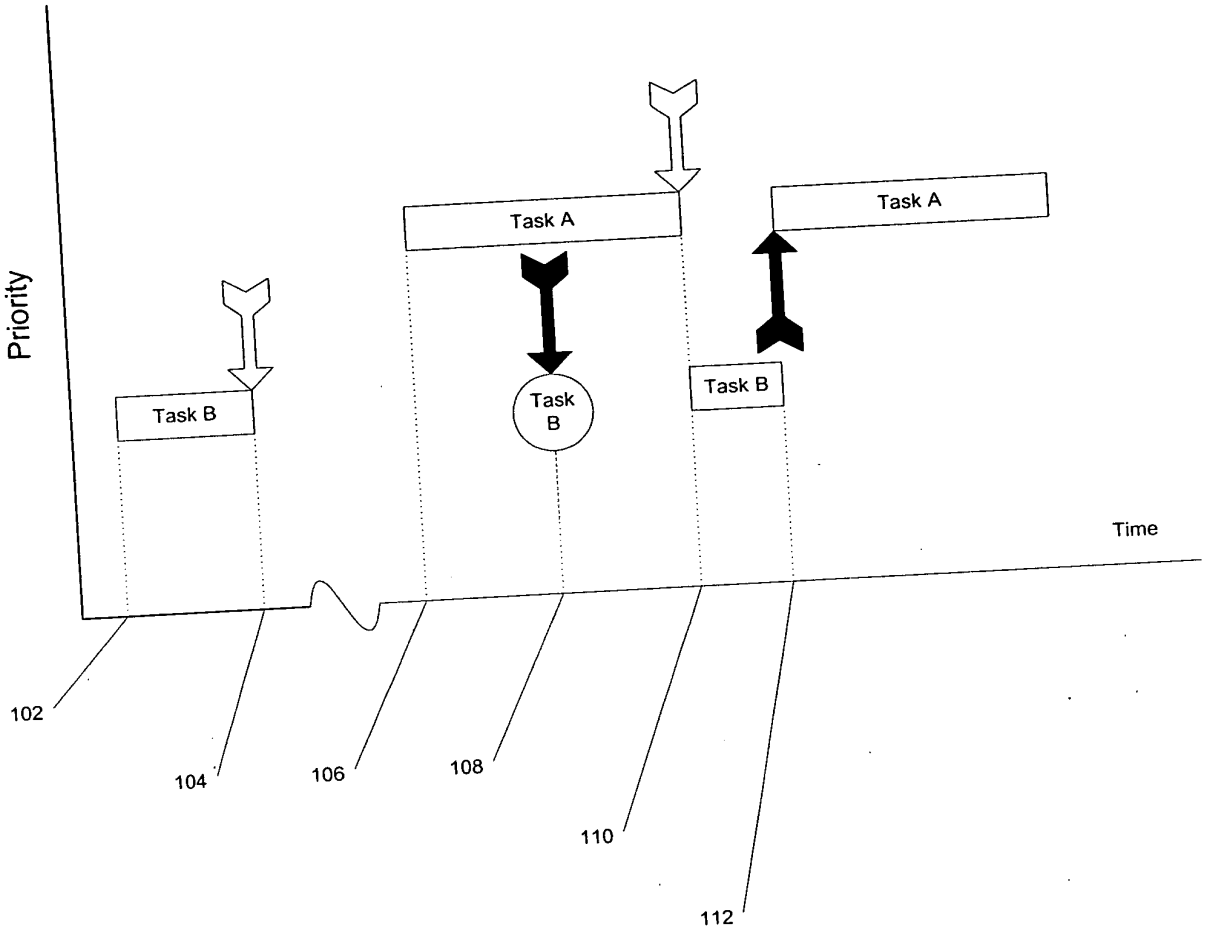
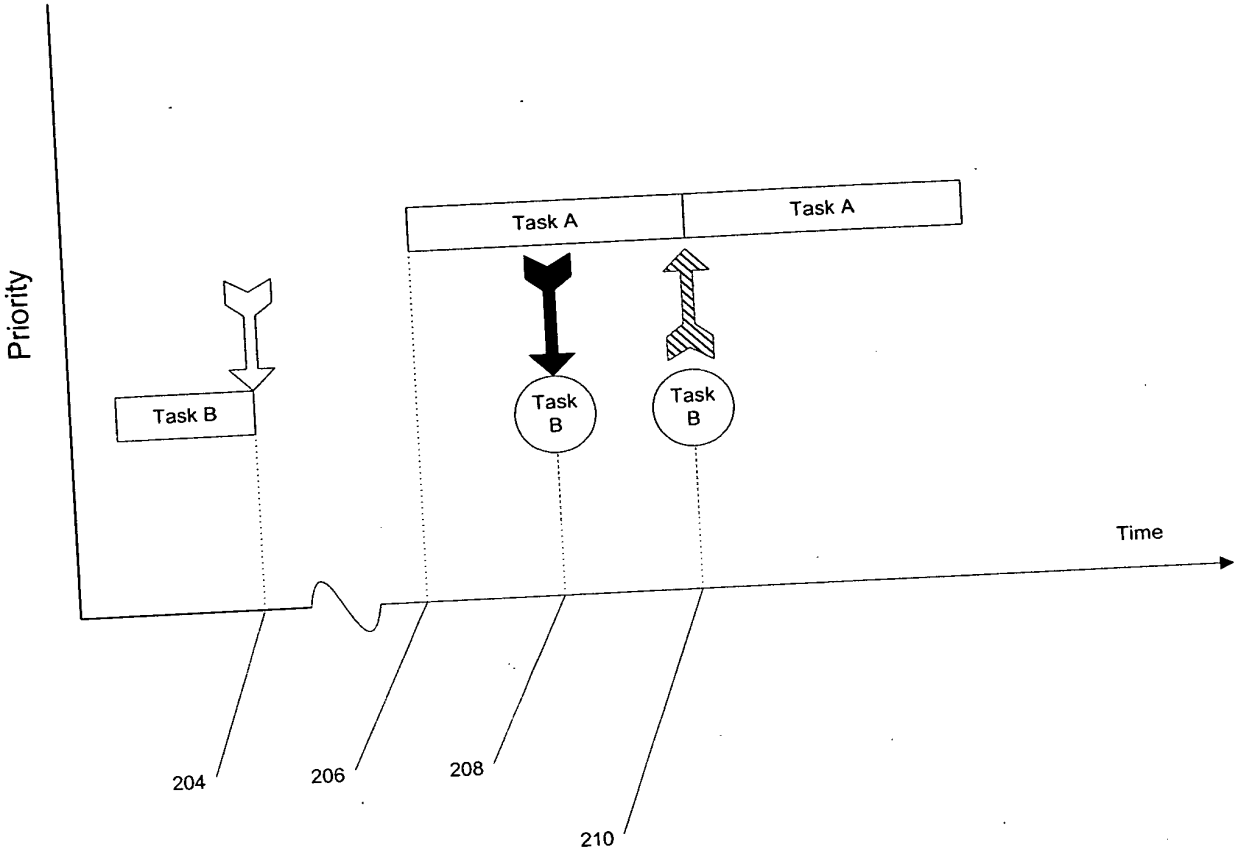


Legend:

Task Receives Resource

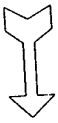
Task Requests Resource That Is Unavailable

Figure 1

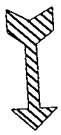


Legend:

Task Receives Resource



Task Requests Resource That Is Unavailable



Resource Is Stolen From Task

Figure 2

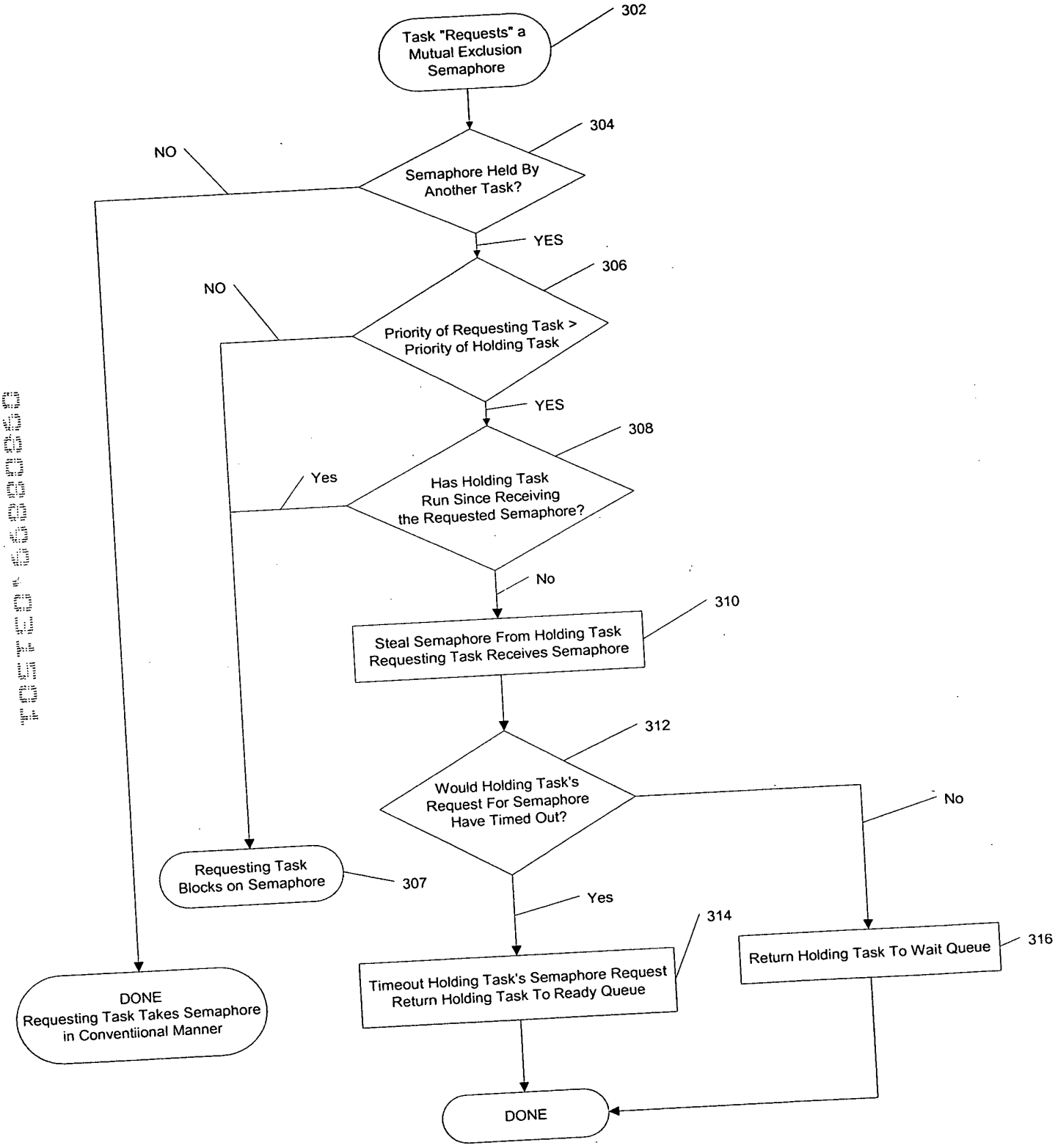

Task "Requests" a Mutual Exclusion Semaphore
302
Semaphore Held By Another Task?
304
NO
YES
Priority of Requesting Task > Priority of Holding Task
306
NO
YES
Has Holding Task Run Since Receiving the Requested Semaphore?
308
Yes
No
Steal Semaphore From Holding Task Requesting Task Receives Semaphore
310
Would Holding Task's Request For Semaphore Have Timed Out?
312
No
Yes
Requesting Task Blocks on Semaphore
307
Timeout Holding Task's Semaphore Request Return Holding Task To Ready Queue
314
Return Holding Task To Wait Queue
316
DONE
Requesting Task Takes Semaphore in Conventiional Manner
DONE

Figure 3

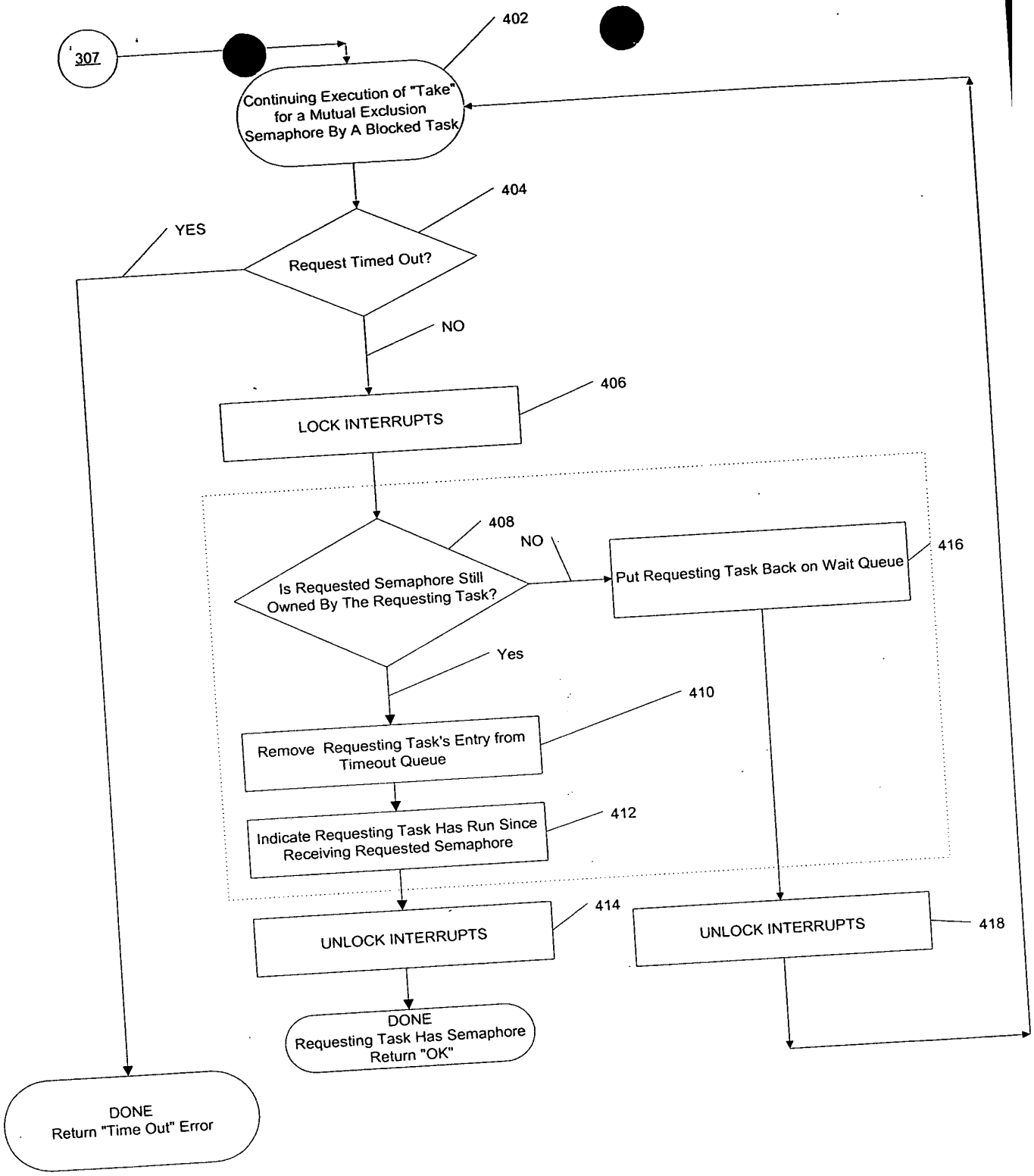

307
402
Continuing Execution of "Take" for a Mutual Exclusion Semaphore By A Blocked Task
404
Request Timed Out?
YES
NO
406
LOCK INTERRUPTS
408
Is Requested Semaphore Still Owned By The Requesting Task?
NO
416
Put Requesting Task Back on Wait Queue
Yes
410
Remove Requesting Task's Entry from Timeout Queue
412
Indicate Requesting Task Has Run Since Receiving Requested Semaphore
414
UNLOCK INTERRUPTS
418
UNLOCK INTERRUPTS
DONE
Requesting Task Has Semaphore
Return "OK"
DONE
Return "Time Out" Error

Figure 4

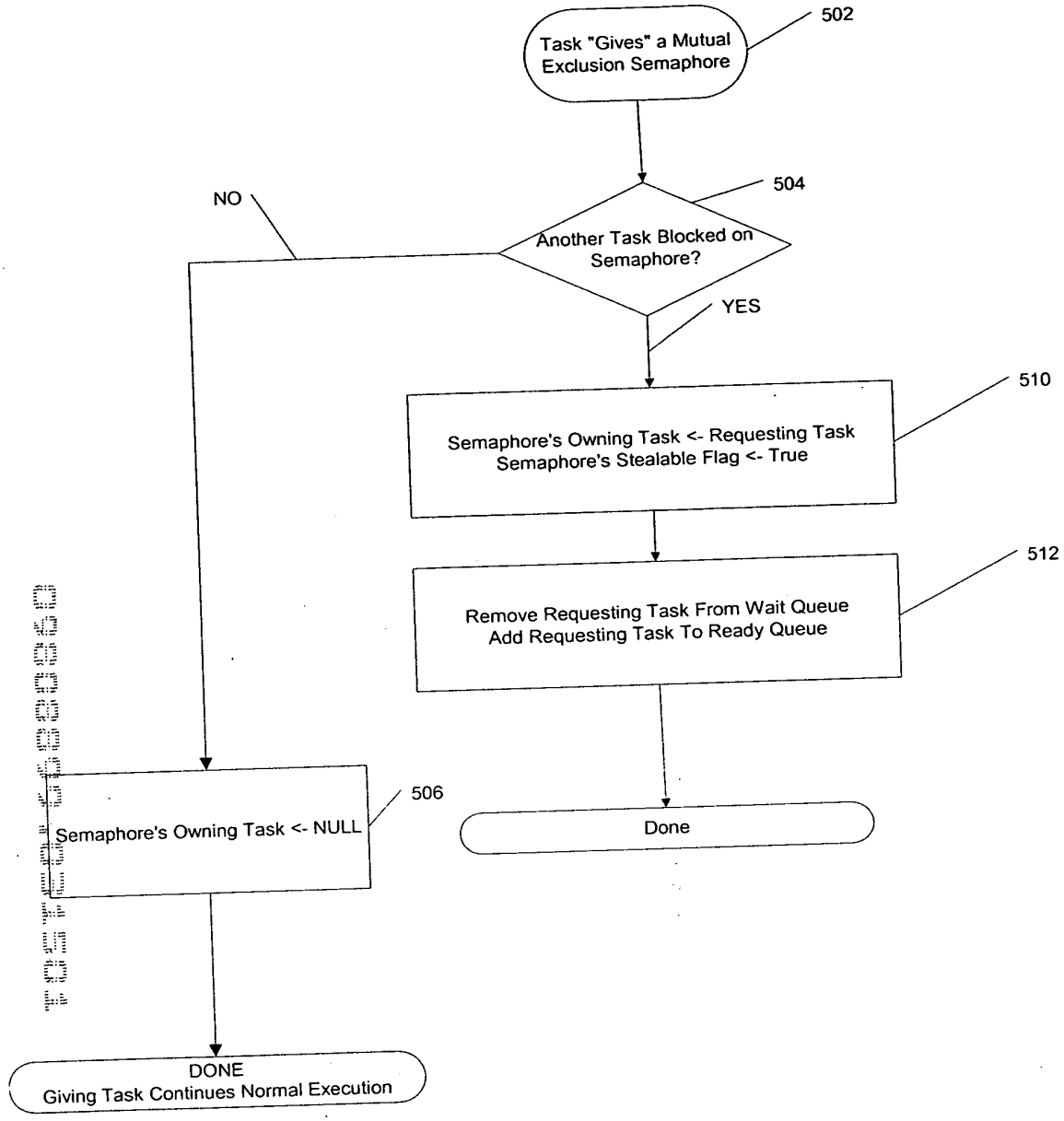

Task "Gives" a Mutual Exclusion Semaphore
502
Another Task Blocked on Semaphore?
504
NO
YES
Semaphore's Owning Task <- Requesting Task
Semaphore's Stealable Flag <- True
510
Remove Requesting Task From Wait Queue
Add Requesting Task To Ready Queue
512
Semaphore's Owning Task <- NULL
506
Done
DONE
Giving Task Continues Normal Execution

Figure 5

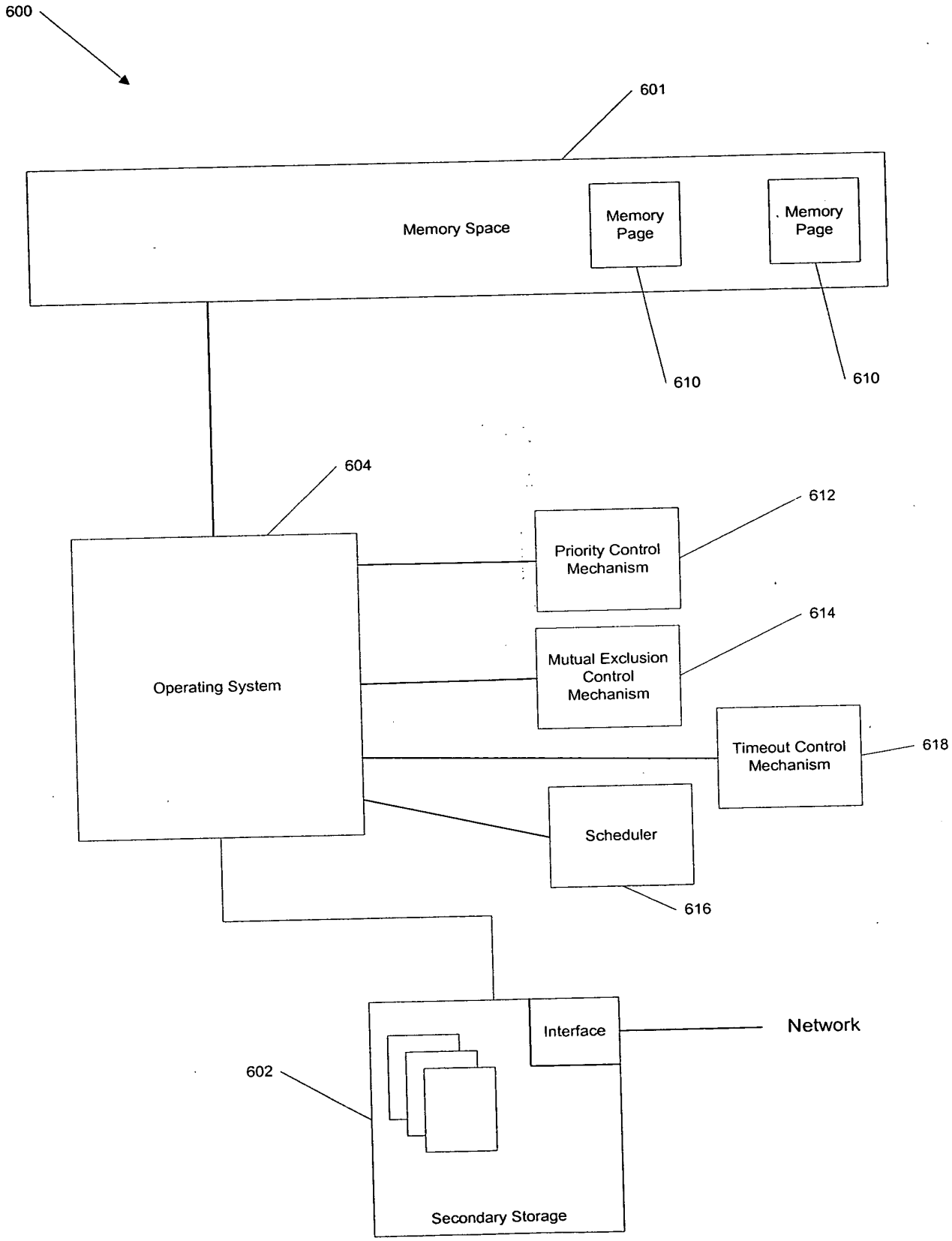

600
601
Memory Space
Memory Page
Memory Page
610
610
604
612
Priority Control Mechanism
614
Mutual Exclusion Control Mechanism
Operating System
Timeout Control Mechanism
618
Scheduler
616
Interface
Network
602
Secondary Storage

Figure 6

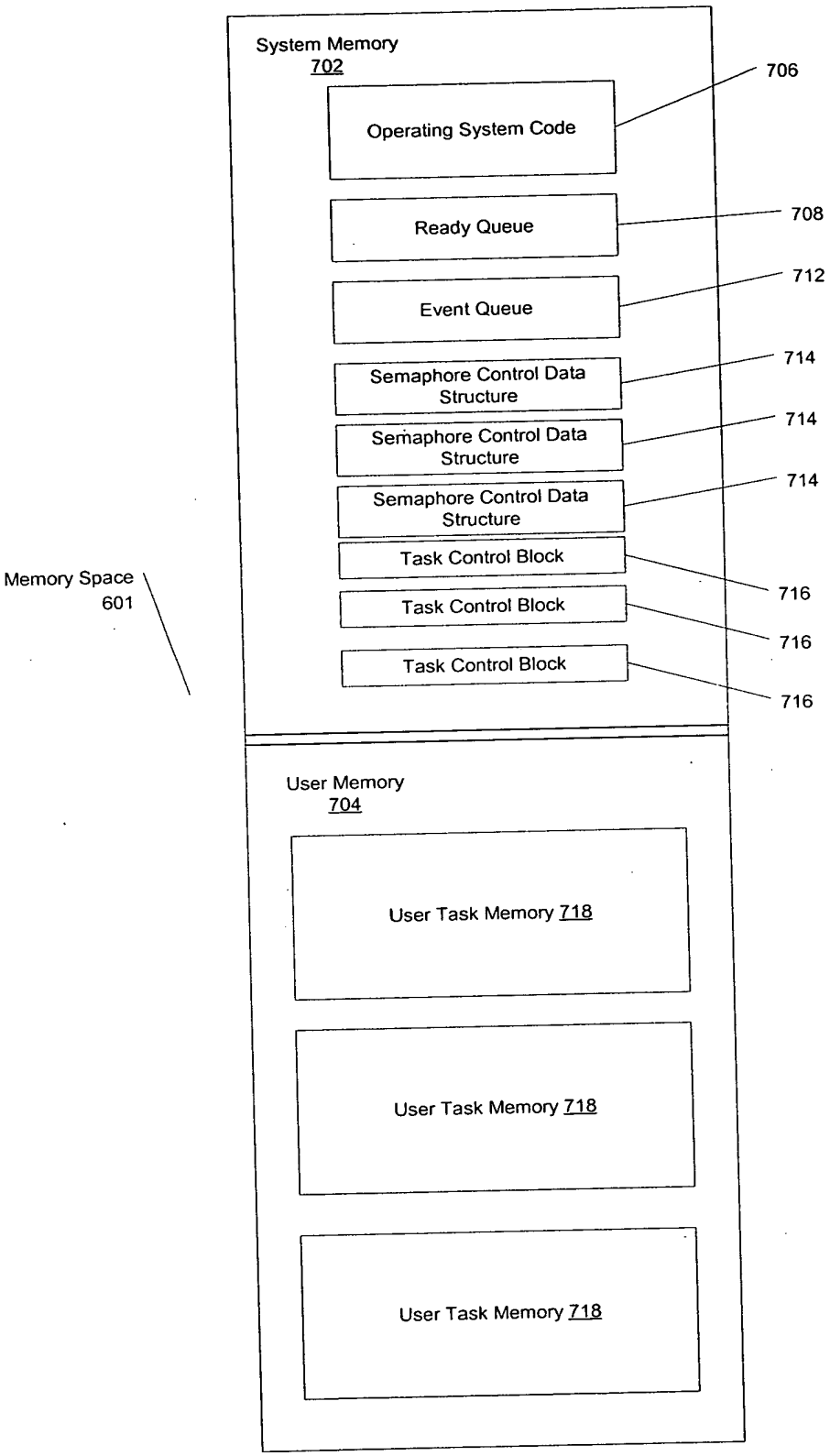

System Memory
702
Operating System Code
706
Ready Queue
708
Event Queue
712
Semaphore Control Data Structure
714
Semaphore Control Data Structure
714
Semaphore Control Data Structure
714
Task Control Block
716
Task Control Block
716
Task Control Block
716
Memory Space
601
User Memory
704
User Task Memory 718
User Task Memory 718
User Task Memory 718

Figure 7

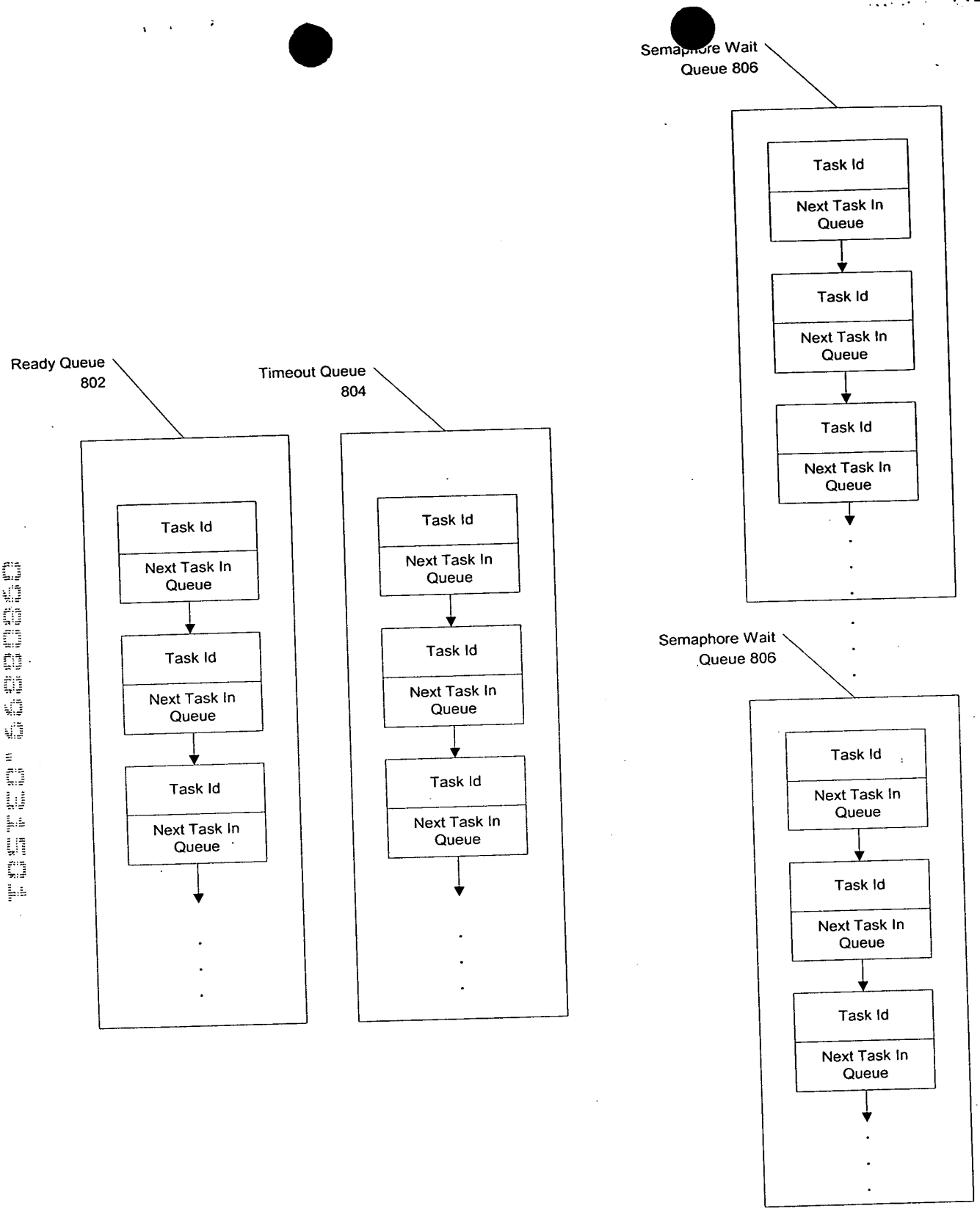

Semaphore Wait Queue 806
Task Id
Next Task In Queue
Task Id
Next Task In Queue
Task Id
Next Task In Queue
Ready Queue 802
Timeout Queue 804
Task Id
Next Task In Queue
Task Id
Next Task In Queue
Task Id
Next Task In Queue
Task Id
Next Task In Queue
Task Id
Next Task In Queue
Task Id
Next Task In Queue
Semaphore Wait Queue 806
Task Id
Next Task In Queue
Task Id
Next Task In Queue
Task Id
Next Task In Queue

Figure 8

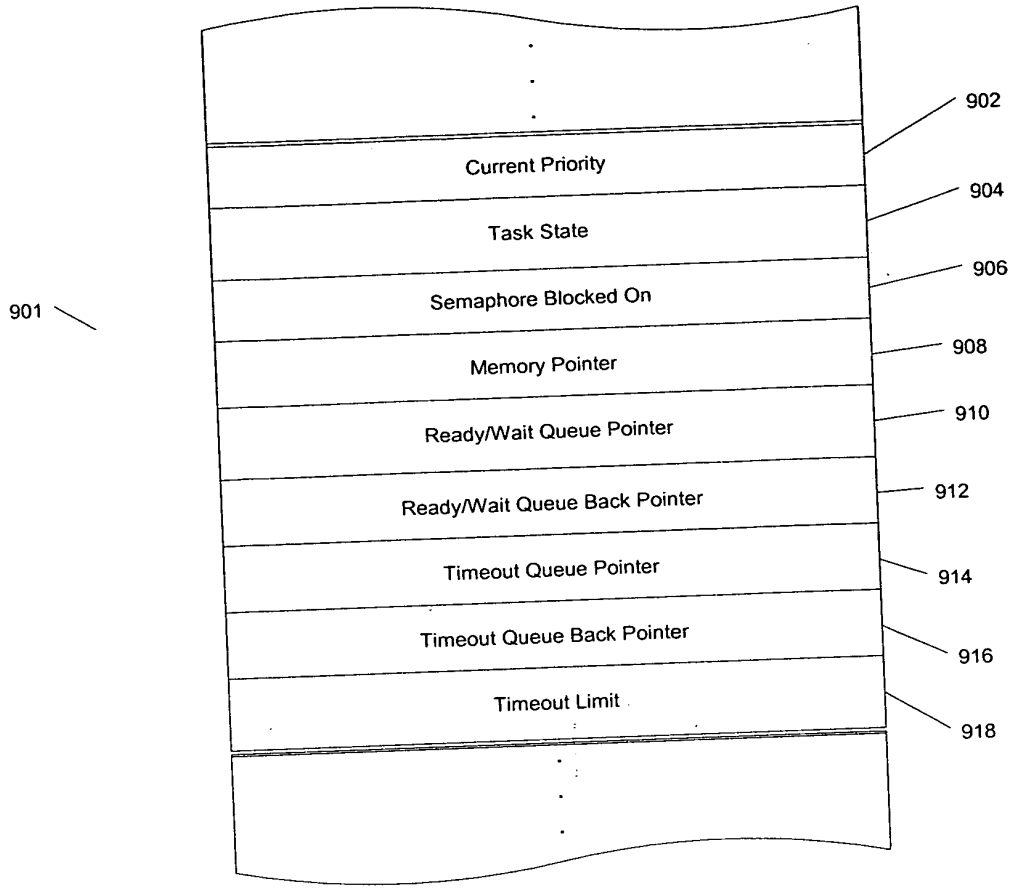

901
Current Priority
Task State
Semaphore Blocked On
Memory Pointer
Ready/Wait Queue Pointer
Ready/Wait Queue Back Pointer
Timeout Queue Pointer
Timeout Queue Back Pointer
Timeout Limit
902
904
906
908
910
912
914
916
918

Figure 9

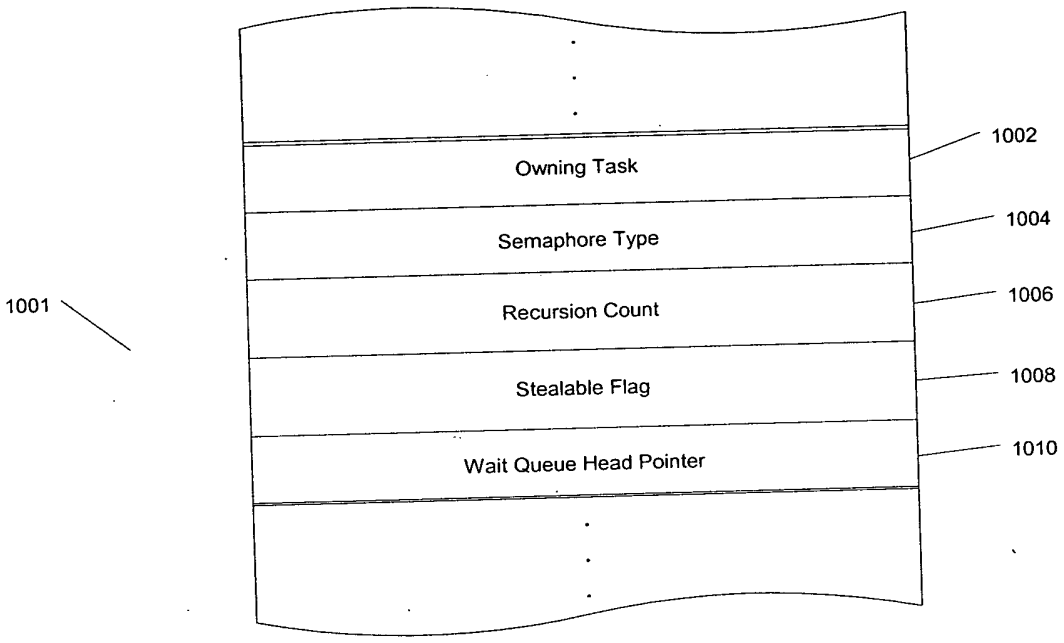

1001
Owning Task
Semaphore Type
Recursion Count
Stealable Flag
Wait Queue Head Pointer
1002
1004
1006
1008
1010

Figure 10

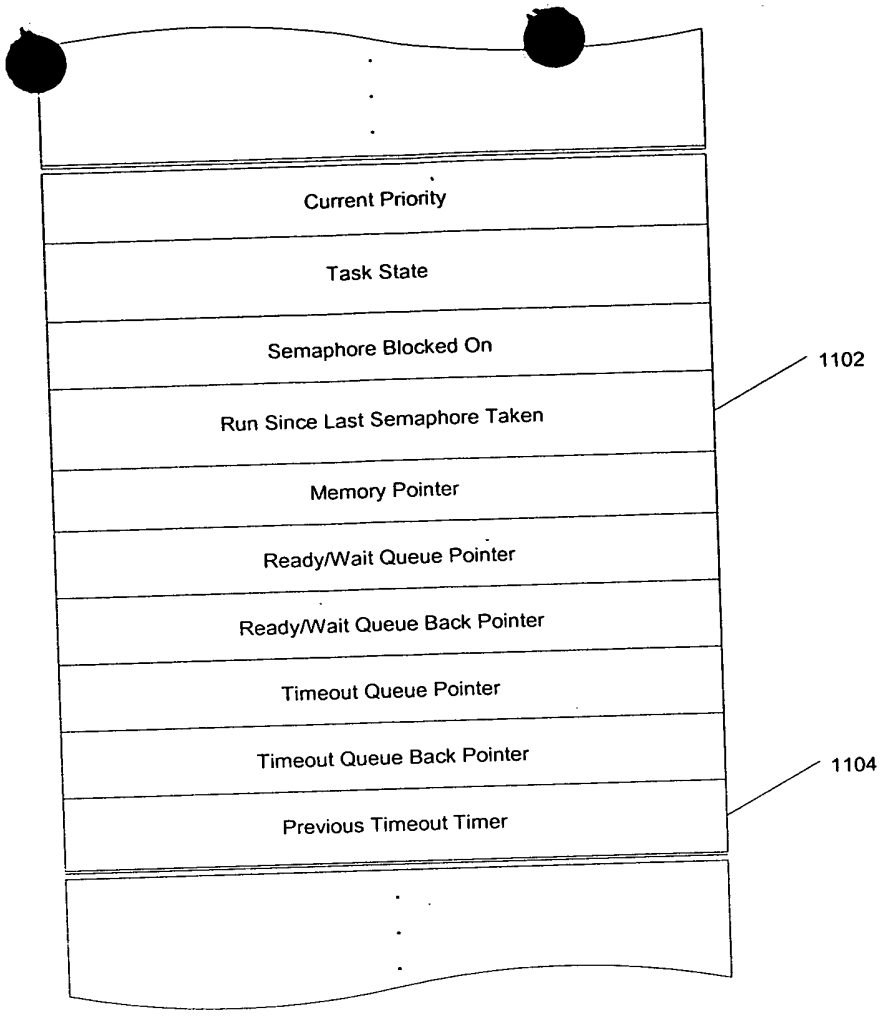

Current Priority
Task State
Semaphore Blocked On
Run Since Last Semaphore Taken
Memory Pointer
Ready/Wait Queue Pointer
Ready/Wait Queue Back Pointer
Timeout Queue Pointer
Timeout Queue Back Pointer
Previous Timeout Timer
1101
1102
1104

Figure 11